

[0001] Prior Art

[0002] The invention relates to a piezoelectric actuator, for example for actuating a mechanical component such as a valve or the like, according to the features in the preamble to the main claim.

[0003] It is generally known that the so-called piezoelectric effect can be used to produce a piezoelectric element comprised of a material with a suitable crystalline structure. When an external electrical voltage is applied, a mechanical reaction of the piezoelectric element occurs, which produces a pressure or tension in a direction that can be predetermined as a function of the crystalline structure and the regions to which the electrical voltage is applied. The structure of this piezoelectric actuator can be laid out in a number of layers, (multilayered piezoelectric actuators) in which the layers are respectively interspersed with the electrodes used to apply the electrical voltage. Such piezoelectric actuators can, for example, be used to operate on/off valves in fuel injection systems of motor vehicles.

[0004] A piezoelectric actuator of this kind is known from DE 100 26 005 A1, in which the outer electrodes are respectively distributed in a net-like or mesh-like fashion over a side surface and are contacted by the respective inner electrodes at least at points. The net-like or mesh-like outer electrodes extend beyond the multilayered structure of piezoelectric layers in such a way that the extensions serve to supply the electrical voltage via appropriate connections.

[0005] Advantages of the Invention

[0006] The piezoelectric actuator described at the beginning, with outer electrodes, which are attached in a net-like or mesh-like fashion in the form of so-called screen electrodes and are contacted by the respective inner electrodes at least at points, is advantageously modified in that the contacting of the inner electrodes is provided in the corner region; the respective net-like or mesh-like outer electrodes are guided around the respective corner in a predetermined region and contact the respective inner electrodes at least in parts.

[0007] In a particularly advantageous embodiment, the respective net-like or mesh-like outer electrode extends further in the direction of the multilayered structure of piezoelectric layers and is provided with a terminal there. It is also advantageous in this case for the extension and the terminal to be disposed in the region of the cross section of the piezoelectric actuator, i.e. on the end surface.

[0008] According to another embodiment form, the respective net-like or mesh-like outer electrode extends laterally from the piezoelectric layers and is provided with a terminal there.

[0009] In every case, the respective net-like or mesh-like outer electrode can be advantageously rolled in the region of the extension and then provided with the terminal. It is particularly advantageous in this case if the respective net-like or mesh-like outer electrode and/or the terminal is/are comprised of Invar so that the outer electrode has the same thermal expansion coefficients as the piezoelectric actuator.

[0010] The respective net-like or mesh-like outer electrode and/or terminal can also be respectively soldered or welded to the inner electrodes.

[0011] Drawings

[0012] Exemplary embodiments of the piezoelectric actuator according to the invention will be explained in conjunction with the drawings.

[0013] Fig. 1 shows a view of a piezoelectric actuator with a multilayered structure comprised of layers of piezoelectric ceramic and a screen-like outer electrode that extends from the end of the layer structure in order to produce a contact,

[0014] Fig. 2 is a top view of the piezoelectric actuator, with the rolled extensions of the screen-like outer electrode according to Fig. 1, with the connections for an electrical voltage,

[0015] Fig. 3 shows a variant of the rolled extensions of the screen-like outer electrode, and

[0016] Figs. 4 and 5 each show a detailed view of the outer electrodes that are either soldered or welded in place.

[0017] Description of the Exemplary Embodiments

[0018] Fig. 1 shows a piezoelectric actuator 1, which is comprised in an intrinsically known way of piezoelectric sheets of a ceramic material with a suitable crystalline structure so that

by making use of the so-called piezoelectric effect, the application of an external electric voltage to inner electrodes 2 and 3 via corresponding electrical connections triggers a mechanical reaction of the piezoelectric actuator 1. Fig. 1 shows one of the contacts on alternating sides – of the inner electrodes 2 in this case – in the corner region of the piezoelectric actuator 1, with a net-like, mesh-like, or screen-like outer electrode 4 that is guided around the respective corner of the piezoelectric actuator 1 in a predetermined region.

[0019] According to Fig. 1, the outer electrode 4 extends with a region 5 beyond the end surface of the piezoelectric actuator 1 and is rolled on one side of the piezoelectric actuator 1, thus enabling contact with an electrical connection 6. Fig. 2 is a top view of this end surface. Fig. 3 shows an alternative embodiment of the rolled extension 5 in the corner region of the piezoelectric actuator 1.

[0020] Fig. 4 is a detailed view of how the screen-like outer electrode 4 is soldered or welded to a base metallization 7 and 8 on the sides of the piezoelectric actuator 1 or, according to Fig. 5, to a base metallization 9 of the piezoelectric actuator 1 extending along the entire corner region.